ECS and MINISTAB System

Capt Johnson

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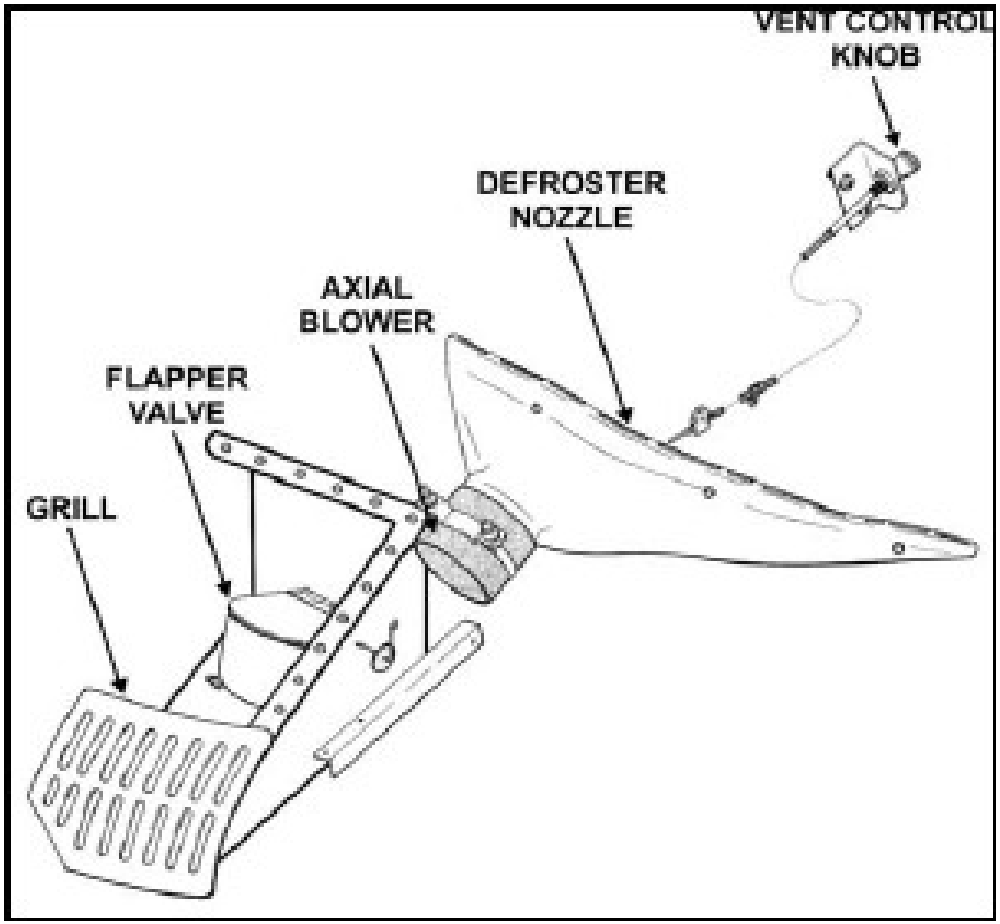

VENT CONTROL
KNOB
DEFROSTER
NOZZLE
AXIAL
BLOWER
FLAPPER
VALVE
GRILL

Two vent controls are mechanically connected to flapper valves, which lock in different positions to vary the amount of air entering the cabin along with diverting air to the defog system when the vent control knobs are pulled out.

Two electrically driven axial flow blowers are installed in the inlet end of the defroster nozzles which maintain a continuous flow of air, depending on the cockpit setting. This defog system is primarily used for ventilation and defogging during ground ops.

Although not required, airflow will be increased when both vent control knobs are pulled full out. The defog system works best when operated in conjunction with the a/c or heater system. To operate :

Turn the air conditioner or heat switch on;

Turn the defog blower on;

Select high or low fan speed and open the air conditioner or heater outlets.

(when using defog in conjunction with a/c or heater, close the ram air vents)

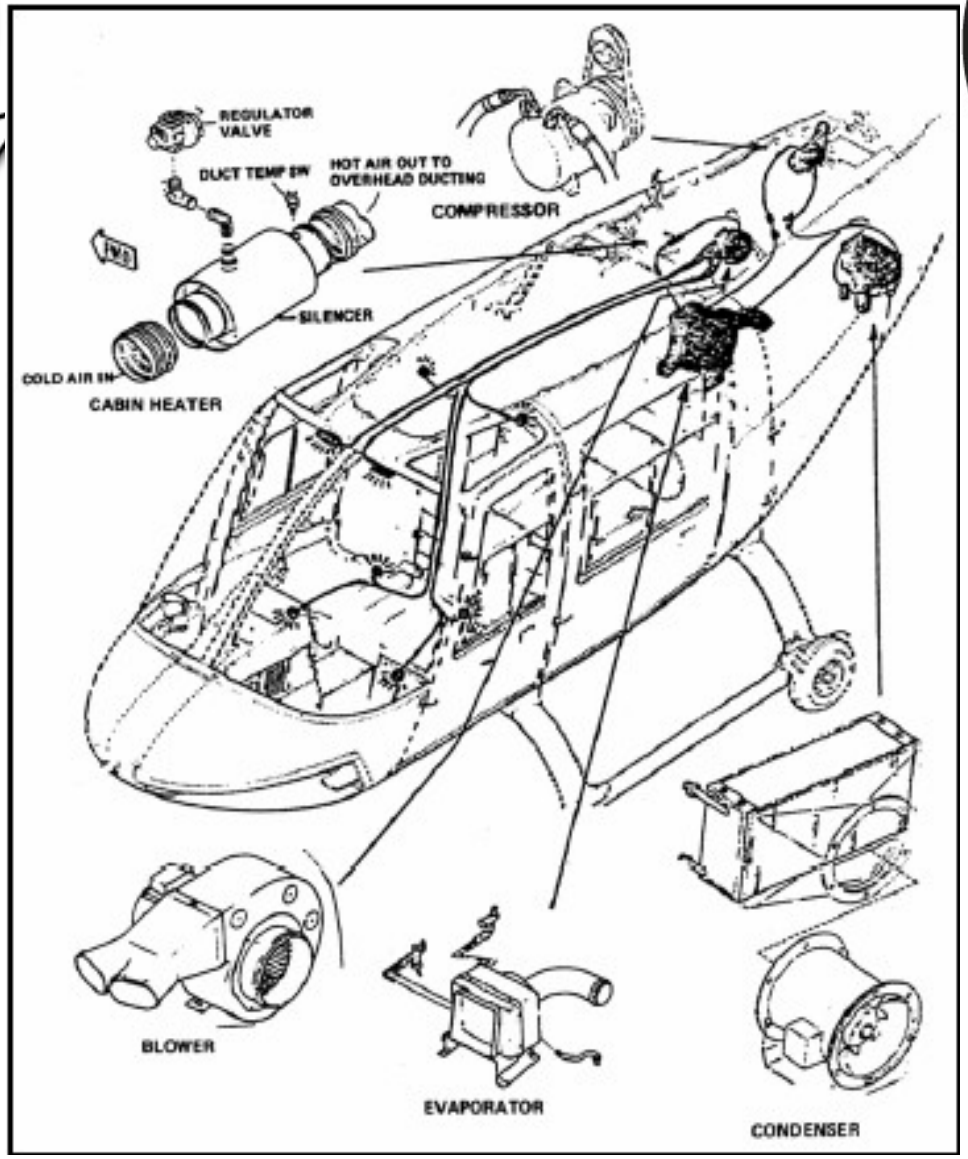
Vapor Cycle Air Conditioner

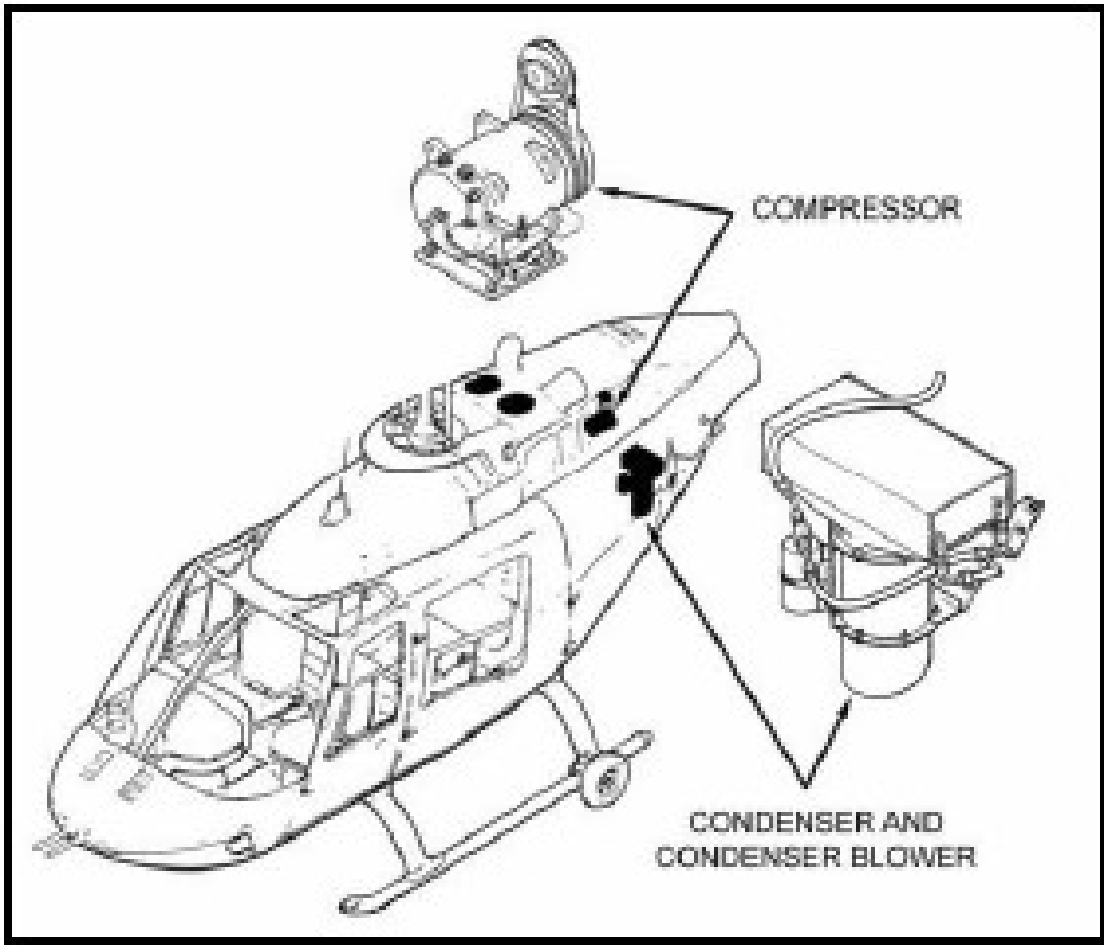
components:

1. Switch panel
2. Compressor
3. Condenser
4. Condenser blower
5. Evaporator
6. Evaporator blower

A/C system requires approximately _____ horsepower to operate.

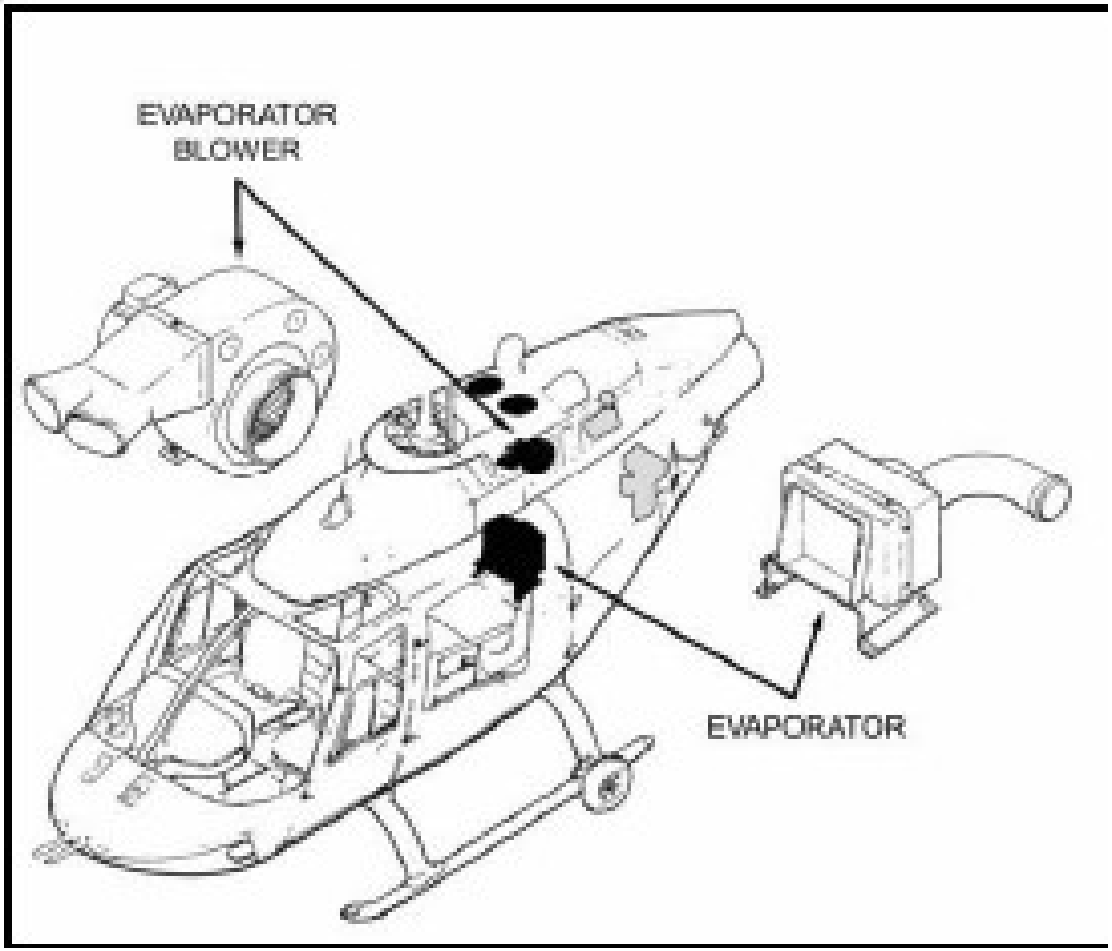
Five


REGULATOR VALVE
DUCT TEMP SW
HOT AIR OUT TO OVERHEAD DUCTING
COMPRESSOR
SILENCER
COLD AIR IN
CABIN HEATER
BLOWER
EVAPORATOR
CONDENSER


COMPRESSOR
CONDENSER AND
CONDENSER BLOWER

The compressor is driven by a pulley and belt arrangement off of the tail rotor drive shaft.

When the electrical circuit to the compressor is completed, an electrical clutch engages and the compressor begins to pump freon gas from the evaporator.


EVAPORATOR
BLOWER
EVAPORATOR

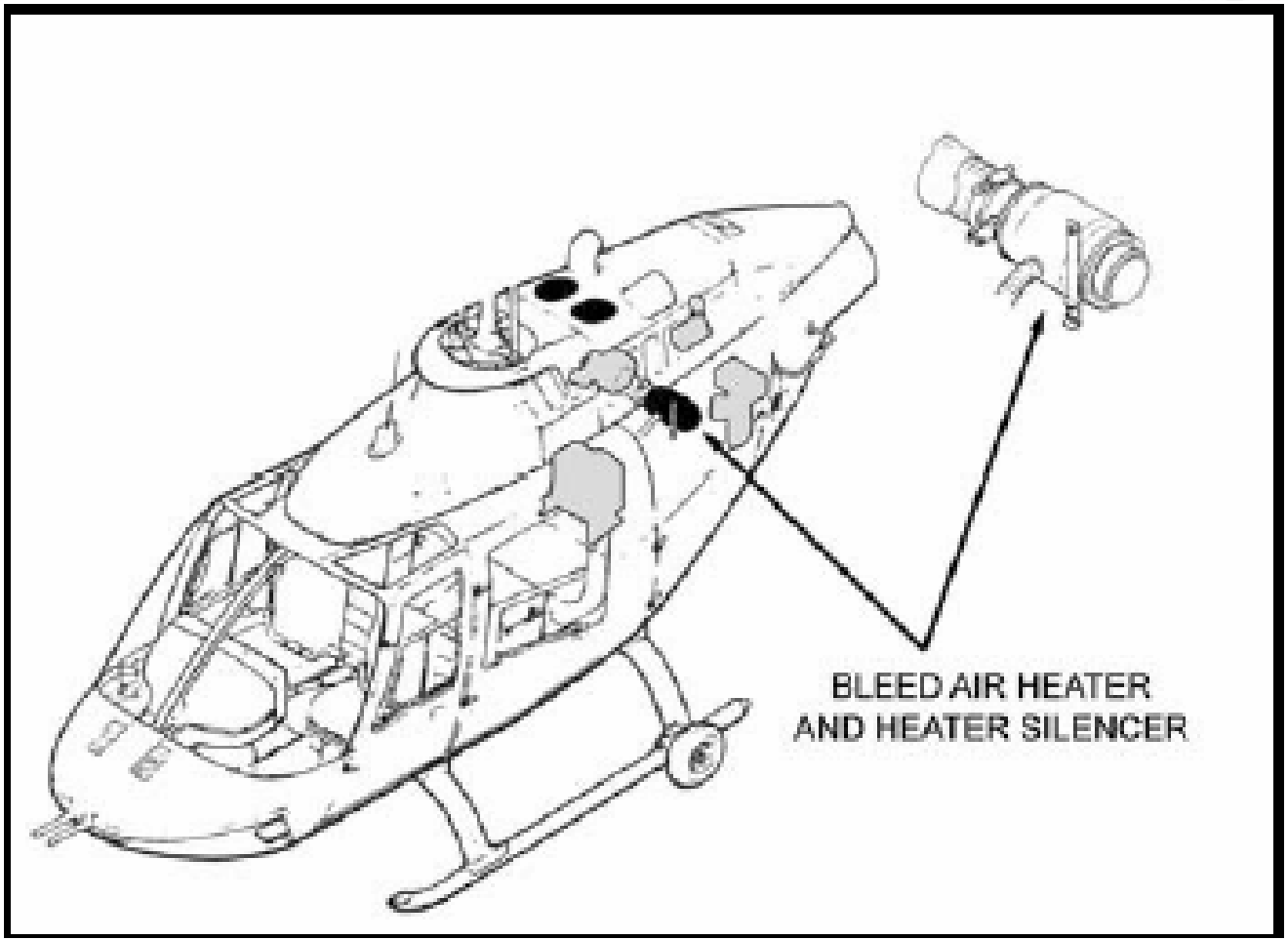
The compressor compresses the gas to a high pressure and temperature and then routes it to the condenser, where the pressurized freon gas flows through the condenser coils and condenses to a liquid when cooled by the condenser fan blowing air over the coils. The liquid freon is then stored under pressure in the receiver dryer located next to the evaporator. The receiver dryer stores the liquid freon for on-demand use of the evaporator.

Flow of freon to the evaporator is controlled by two thermostatically controlled expansion valves. The expansion valves work on temperature and pressure. With the compressor operating, a low pressure is created from the evaporator to the compressor, and the expansion valves open, providing a means to meter the liquid through the evaporator at a rate so it will be a gas by the time it reaches the compressor.

As the liquid passes through the expansion valves and enters the low pressure evaporator, it reverts back to a gas (absorbing heat). During this processes while the gas is absorbing heat and cooling the evaporator coils, the evaporator fan is pulling cabin air through the coils and returning cool air back to the cabin.

Bleed Air Heater

Inlet side of the heater system is connected to the ventilation ducting coming from the evaporator and the outlet is connected by ventilation ducting to the evaporator blower. The control valve on the overhead console determines the amount of bleed air mixing with cabin air by governing the airflow to the regulator valve. With the regulator valve open, a proportional amount of engine bleed air enters the heater silencer, which then mixes with cabin air and is circulated by the evaporator fan. A duct temp switch in the heater silencer monitors the air temp in the outlet side of


BLEED AIR HEATER
AND HEATER SILENCER

Heater Malfunction

Indications: DUCT TEMP HIGH caution light illuminated

Procedures:

1. CABIN HEAT valve – OFF
2. AIR COND/FAN switch – FAN
3. HI/FAN/LO switch – HI

If light extinguishes:

4. Continue flight

If light does not extinguish:

5. Land as soon as practical

MINISTAB

The MINISTAB is a basic three-axis stabilization system with force trim and rate dampening in all three axes.

Each axis includes a:

- Trim Damper Unit
- Computer
- Actuator

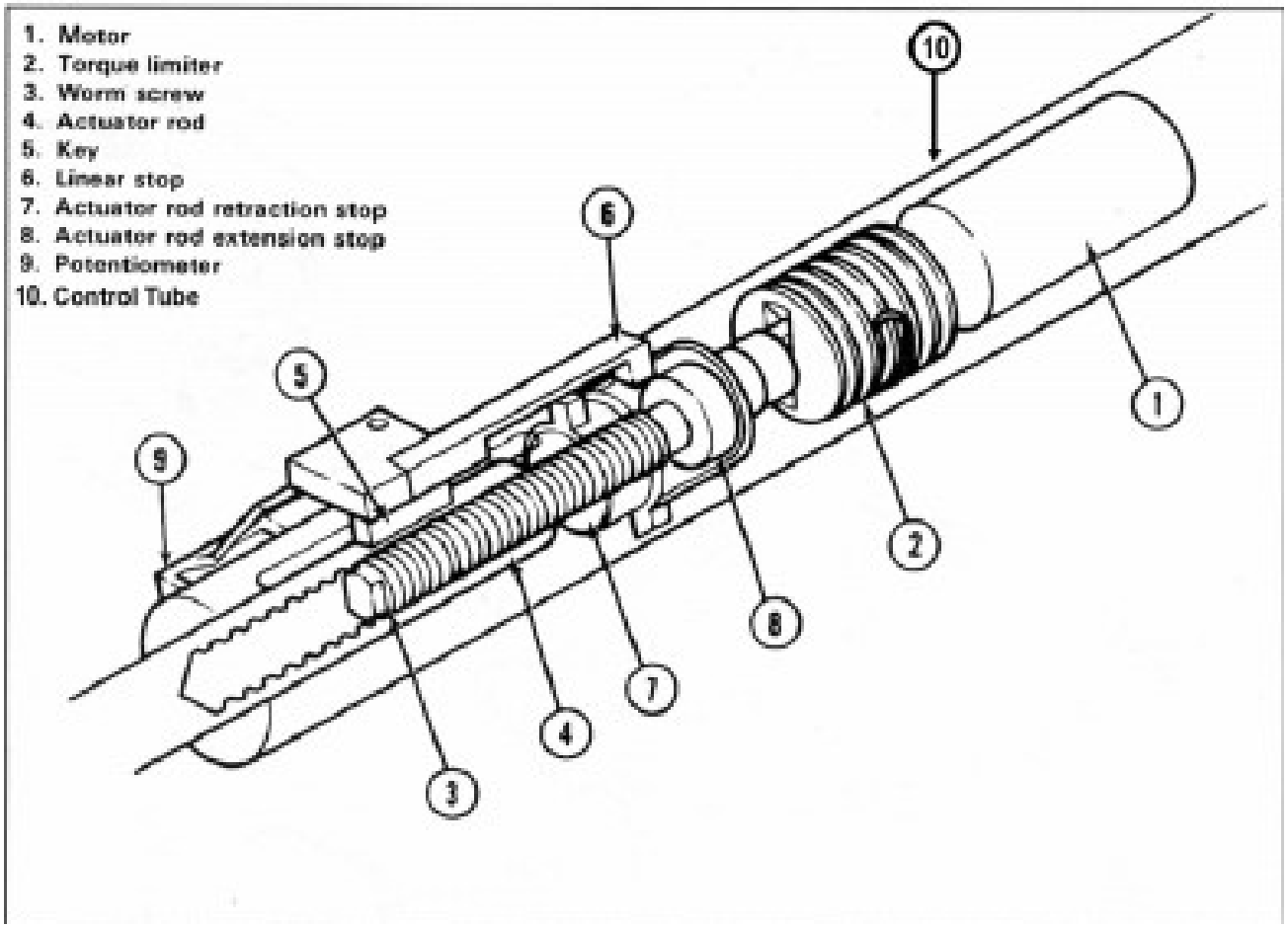
The air data computer provides airspeed and altitude information to the system and the controller and actuator position indicator provide the pilot with system information.

A Junction box works with all three axis

Electromechanical Actuator

Installed in the top of the cyclic control tube with the output shaft connected directly to the hydraulic booster pilot valve input. The rudder actuator is installed in line with the tail rotor control tube.

Signals from computers cause the actuator to move about a neutral point, with cyclic actuators moving simultaneously (opposite directions for roll input and in the same direction for pitch input)


1. Motor
2. Torque limiter
3. Worm screw
4. Actuator rod
5. Key
6. Linear stop
7. Actuator rod retraction stop
8. Actuator rod extension stop
9. Potentiometer
10. Control Tube

YM

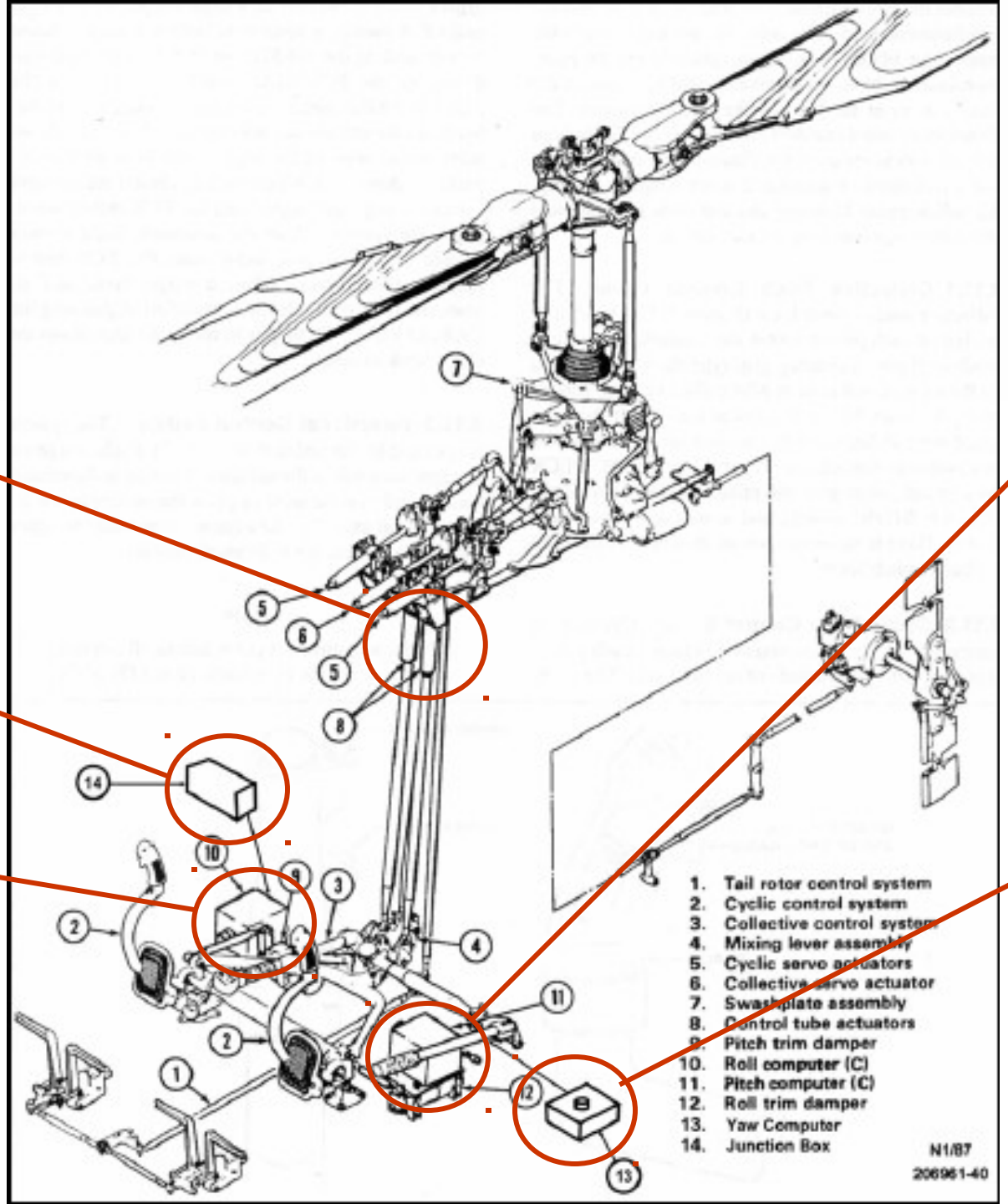
Trim Damper Unit

TDU’s are multipurpose with force trim and damper sections.

- The force trim operates as a standard force gradient, providing artificial feel while maintaining the last control position.

- The damper serves to smooth pilot input into the AFCS.

(Microswitch’s located in pitch and roll TDU)


Control tube actuators
Junction Box
Roll computer / Pitch trim damper
Pitch computer / Roll trim damper
Yaw computer
1. Tail rotor control system
2. Cyclic control system
3. Collective control system
4. Mixing lever assembly
5. Cyclic servo actuators
6. Collective servo actuator
7. Swashplate assembly
8. Control tube actuators
9. Pitch trim damper
10. Roll computer (C)
11. Pitch computer (C)
12. Roll trim damper
13. Yaw Computer
14. Junction Box
N1/87
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Junction Box interconnects components of the system

Roll computer and junction box are located under the pilot's seat
Pitch and Yaw computers are located under the copilot's seat.

All three axis computers are identical, containing a:

- rate gyro
- memory circuit (integrated rate)
- Integration Cutoff (ICO) circuit

The rate gyro senses movement about its axis, with the computer detecting any deviation from the "attitude" stored in the memory circuit. The computer sends a correction signal to the actuator, which makes the appropriate control input.

ICO occurs when:

1. The pilot moves the cyclic or pedals, in the axis of flight control movement only (above 40 kts a roll input will also ICO the yaw axis).

2. The pilot depresses the cyclic force trim button, in the roll and pitch axis (above 40 kts, this will also cause yaw axis ICO).

3. The force trim system is off.

Attitude retention (integration) is restored when **all** of the following conditions are met:

1. The pilot ceases to apply control inputs.

2. The cyclic force trim button is released.

3. Movement about the axis falls below 1.5° per second.

4. The force trim system is on.

To change to a new pitch attitude:

move the cyclic fore or aft and a microswitch in the pitch TDU senses the movement and activates the pitch computer ICO.

Once control movement stops, the computer waits for movement about its axis to stabilize below 1.5º per second…and 900 milliseconds later the ICO is secured again. This delay lets the aircraft settle down, then the computer maintains the new attitude.

To accomplish new roll attitudes, equal signals are sent to both cyclic actuators, except one signal is reversed in polarity for roll input, left or right. Again, lateral cyclic movement causes ICO to occur and once the aircraft stabilizes, the roll computer maintains the new roll attitude.

For the yaw axis, the principle is the same. A rate gyro in the yaw computer senses changes about its axis and makes inputs to the tail rotor controls to hold the last heading set. The yaw system has the microswitches located in the pedal assemblies and not in the TDU. To change heading, move the pedals to the new setting.

The microswitch will ICO the computer and once the computer detects the aircraft has settled down, it will maintain the new heading.

Depressing the altitude hold button on the controller will engage the air data computer and maintain the selected altitude. The air data computer contains an airspeed trip switch, which prevents the altitude hold function from working if airspeed is less than 40 kts.

With airspeed above 40 kts, and altitude hold engaged, the altitude hold circuits of the air data computer will determine if the aircraft is above or below the desired altitude. Then an altitude error pitch signal that is proportional to the amount of error is sent to momentarily cause the pitch computer to go to ICO. Notice, altitude hold only affects the PITCH AXIS. Roll and yaw are not affected.

If you are low, pitch angle will change to raise the nose and as a result, airspeed will decrease.

The air data computer will maintain altitude except that if the computer senses an altitude error signal greater than 150 feet, the air data computer will automatically disengage.

With the MINISTAB in operation the VNE is reduced to 122 kts at density altitudes of 3000 and below. The VNE for aircraft flying above 3000 feet density altitude will depend on gross weight and density altitude flown. Check your NATOPS for other restrictions.